



Efficacy and safety of holmium laser lithotripsy in the treatment of posterior urethral stones

Treatment of posterior urethral stones

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Abstract

Aim: Urethral stones constitute less than 1% of the stones observed in the urinary system. Due to their rare occurrence, there is a limited number of studies on the treatment of urethral stones. In this study, the efficacy and reliability of holmium laser lithotripsy applied to male patients with posterior urethral calculi were analyzed retrospectively. **Material and Method:** Forty-one cases of male patients who received holmium laser lithotripsy due to posterior urethral stones between January 2011 and December 2017 were retrospectively reviewed. The complications of the patients were evaluated according to age, application complaints, stone dimensions, etiologic factors, operation time, and modified Clavien classification. **Results:** The mean age of the patients was 38.4 ± 16.7 years. Acute urinary retention was recorded in 26 (63.4%) patients, hematuria in 4 (9.8%), difficulty in urinating in 5 (12.1%), perineal pain in 4 (9.8%), and dysuria in 2 (4.9%) as the main admission finding. The smallest stone size was 9 mm and the largest stone size was 24 mm. Twenty-four of the 41 patients (58.5%) were found to have a stone in another localization of the urinary system along with the urethra stone. A total of 11 (26.8%) patients had a history of previous urological surgery. **Discussion:** In the present retrospective study, 41 male patients with posterior urethral stones were successfully treated using endoscopic holmium laser lithotripsy with low complication rates.

Conclusion: According to the results obtained in our study, holmium laser lithotripsy was an effective and reliable method for the treatment of posterior urethral stones.

Keywords

Posterior; Urethral Stone; Holmium Laser; Lithotripsy

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Introduction

Urethral stones are rarely seen pathologies and comprise less than 1% of all genitourinary system stones. Compared to western societies, it is more common in developing countries, especially Middle Eastern and Asian countries¹. Urethral stones can be seen as primary urethral stones, mostly migrating from the bladder, ureter, or kidney to the urethra, resulting in secondary urethral stones. Several etiological factors such as urethral stricture, urinary tract infection, foreign body, previous urethral surgery, pelvic trauma, urinary schistosomiasis, urethral diverticulum, and fistula play a role in the formation of urethral stones²⁻⁴. Although these stones can be seen in every part of the urethra, they most frequently appear in the posterior urethra; the most commonly observed stone type is calcium oxalate⁵. Since urethral stones are rarely observed, previously published studies are mostly case reports or studies that do not contain a large series. There is no detailed information about the risk factors, diagnosis, treatment, and follow-up approaches compared to other patients with urinary system stone disease. In this study, we retrospectively analyzed the efficacy and reliability of holmium laser lithotripsy which was performed in male patients with the diagnosis of posterior urethral stone.

Material and Method

The records from a total of 41 male patients with posterior urethral stone who underwent holmium laser lithotripsy between January 2011 and December 2017 were examined retrospectively. Patients with missing data or those who were treated with different treatment modalities other than holmium laser lithotripsy were excluded from the study. The study was carried out in accordance with the ethical principles of the Helsinki Declaration.

Preoperative evaluation was performed with a medical history form recorded by the physician, complete urinalysis, urine culture, routine biochemical, hematological examinations, direct urinary system graphy and non-contrast abdominal tomography.

Age, admission complaints, stone dimensions, etiologic factors, operative time, and complications were analyzed retrospectively. After evaluation of the clinical presentation of the patients with the urethral stone diagnosis, percutaneous suprapubic cystostomy catheter was applied to the patients with globe vesicle, complicated urinary tract infection, and acute postrenal failure. Before catheterization, all the patients were evaluated by urinal ultrasonography in terms of compliance with the procedure. No patients had pathology that would prevent suprapubic catheterization, such as bladder cancer or insufficient bladder filling. A urine culture was taken from each patient and a wide spectrum antibiotic was started. Endourological interventions were performed after the urine culture was sterile. Lidocaine gel (2%) was applied into the urethra in the lithotomy position. Cystourethroscopy was performed using a 0-degree lens passed into a 19.5 Fr or 22 Fr endoscope. Additionally, internal urethrotomy was performed during cystourethroscopy to the patients with urethral stenosis. After the urethral stones were reached they were advanced to the bladder in order to perform holmium laser lithotripsy. In-situ holmium laser lithotripsy was applied to the stones that could not be advanced to the bladder. Holmium:

Yttrium-Aluminum-Garnet laser device (LISA Laser Sphinx 60, Germany) was used as a lithotripter. During lithotripsy, different probes 272 μ and 550 μ were preferred depending on the size of the stone. Sterile 0.9% NaCl solution was used for fluid irrigation during the procedure.

All patients underwent similar surgical intervention and the procedures were performed under general or spinal anesthesia. Complications were analyzed according to modified Clavien classification⁶ (Table 1).

Patients data were expressed as mean \pm standard deviation (minimum maximum). SPSS (Statistical Package for the Social Sciences in PASW Statistics) version 18.0 software was used for data analysis.

Results

The age range of the patients was 18-77 years and the mean age was 38.4 \pm 16.7 years. Acute urinary retention in 26 patients (63.4%), hematuria in 4 patients (9.8%), difficulty in urinating in 5 patients (12.1%), perineal pain in 4 patients (9.8%), and dysuria in 2 patients (4.9%) were recorded as the main admission findings. Concurrently, 3 patients had high fever and one patient had postrenal acute renal failure. There was growth in the urine culture in 23 (56.1%) of the patients participating in the study. The most common microorganism was *Escherichia coli* (60.9%). The smallest stone size was 9 mm and the largest stone size was 24 mm. In all patients, except three, a single stone was observed. In these three patients, two stones were found in the prostatic urethra. Twenty-four of the 41 patients (58.5%) were found to have stones in another localization of the urinary system along with the urethral stone. Of these 24 patients, 15 had kidney stones, 4 had bladder stones, 2 had ureter stones, and 3 had both kidney stones and bladder stones. When the anamnesis forms were retrospectively evaluated in detail, we found a history of open prostatectomy in one patient, pelvic trauma in two patients, endoscopic ureteral stone surgery in two patients, percutaneous nephrolithotomy in one patient, transurethral resection of the prostate in five patients, and endoscopic cystolithotomy in two patients. One patient diagnosed with neurogenic bladder was found to have a clean intermittent catheterization with irregular intervals.

During the preoperative evaluation, two patients were found to have ureteral stones, and these patients additionally received endoscopic ureteral stone surgery. Similarly, there were bladder stones in seven patients, who received endoscopic cystolithotomy. The fragmentation of the stones was performed by holmium laser lithotripsy. A total of 17 (41.5%) patients underwent internal urethrotomy during cystourethroscopy upon the finding of urethral stricture. Complications were not observed in patients undergoing simultaneous operation. The duration of operations was determined by removing the time of the stated endourological procedures from the total time recorded for the surgical procedure. The mean duration of operation was recorded as 32.9 \pm 10.6 minutes. In a total of 29 (70.7%) patients the urethral stone was successfully advanced into the bladder. Using holmium laser lithotripsy, the stones in the bladder were successfully fragmented and taken out with the help of forceps or evacuator. A hematuria which lasted less than 24 hours and did not require blood transfusions was observed

in three patients. A total of 12 (29.3%) patients underwent in-situ holmium laser lithotripsy since the urethral stones could not be advanced into the bladder. All stones were successfully fragmented and taken out with the help of forceps. Three of 12 patients, who underwent in-stu litotripsi, two of them did not require blood transfusions and had a hematuria for less than 24 hours, whereas one patient had urinary tract infection. When postoperative complications were evaluated according to the modified Clavien classification, grade 1 complication was observed in five patients and grade 2 complication was observed in one patient. None of the patients had grade 3 or higher complications.

Discussion

Urinary tract stone diseases are among the oldest known diseases in the history of mankind⁷. Urinary infections and prostate diseases are the two most common pathologies affecting the urinary system; the third most common are urinary system stone diseases. The prevalence of urinary system stone disease varies in relation to many factors such as geographical region, ethnicity, and socioeconomic conditions⁸.

In Turkey, in the study by Akinci et al., the urinary system stone disease prevalence was reported as 14.8% and incidence as 2.2%⁹. In another study conducted in our country, Muslumanoğlu et al. examined 2468 participants in the age range of 18-70 years living in 33 different regions, and reported that 11.1% of the participants diagnosed by healthcare workers had a history of urinary system stone disease¹⁰. Among the urinary system stones, urethral stones are rarely seen pathologies and constitute less than 1% of all genitourinary system stones¹. In the female population, urethral stones are extremely rarely seen pathologies¹¹.

The diameter of the male urethra is approximately 10 mm. Theoretically, the normal urethral lumen allows the natural passage of small stones through this dimension¹². Pathologies that constrict the normal urethral diameter in any part of the ureter may cause stone formation in the urethra, as well as obstruct the passage of stones from other localizations of the urinary system and lead to a big increase in their size. As to the study conducted by Kiciler et al. in our country, urethral pathology which can cause stone formation in 64.7% of patients with urethral stone was not determined. In the same study, 47.1% of the patients were found to have stones in the urinary system in any location other than the urethra¹³. Urethral stones can be seen as primary urethral stones, mostly migrating from the bladder, ureter, or kidney to the urethra, resulting in secondary urethral stones²⁻⁴. Jung et al. reported that in their retrospective multicenter study of 221 patients with 194 bladder stones and 27 urethral stones that 63% of patients with urethral stones had concurrent upper urinary tract stones. In addition, in the same study, upper urinary tract stones and/or hydronephrosis reported a three-fold increase in urethral stone risk¹⁴. In a similar study, Takasaki et al. examined a total of 300 patients with 273 bladder and 27 urethral calculi. In 57.9% of patients with urethral stone, they found stones in the upper urinary tract¹⁵. In our study, urethral stricture was observed in 41.5% of patients, and 64.7% of these patients had a history of urological surgery. In addition, in our study 58.5% of patients were found to have

stone in another localization of the urinary system along with urethral stone.

Male patients with urethra stone may present with very different findings, such as symptoms of the lower urinary tract: acute urinary retention, hematuria, difficulty in urinating, and frequent urination and also with palpable urethral mass, penile pain, pain in the rectal or perineal region, urinary tract infection, and sepsis. It should be kept in mind that admission findings vary due to the size of the stone, localization, the patient's urethral anatomy, and the time of onset of symptoms. While posterior urethral stones typically cause pain in the perineal region, stones in the anterior region typically cause pain in the penile region. In the same way, stones that reach a large size usually cause acute urine retention, while small stones lead to the lower urinary system complaints. At the same time, the urethral anatomy of patients is extremely important in the presentation of patients with urethral stones. The stones that can easily pass through the natural urethral lumen can cause acute urinary retention secondary to staying in the urethral stricture. In addition to all these, it should be remembered that in late-diagnosed patients, urinary system infections can be seen and may even progress as far as sepsis. In the study of 51 male patients diagnosed with urethral calculus by Kamal et al., 78% of the patients reported that they applied with acute urinary retention⁵. Similarly, Amin et al. presented this rate as 89%¹⁶. At the same time, in the study by Sharfi, of 36 cases diagnosed with urethra stone, they reported that the most common admission finding was dysuria (33.3%). In the same study, 22% of the patients were reported as admitted with acute urinary retention¹⁷. Similarly, the study by Kilciler et al. found that the most frequent complaint was dysuria (64.7%)¹³. In another study that analyzed patients with urethral calculi, Verit et al. reported that 46.7% of patients had acute urinary retention, 26.7% had decreased urinary flow, 20% had penile or perineal pain, and 6.6% had gross hematuria¹. Examining studies conducted in recent years, we can see that urethral stones, although rarely, can lead to life-threatening clinical situations. For example, in case reports presented in the literature by Ramdass and Naraynsingh, it has been shown that penile urethral stone is associated with sepsis and penile gangrene¹⁸. Similarly, Selli et al. evaluated 14 patients who were diagnosed with urethral calculus and reported that sepsis occurred in one patient¹². In our study, the most frequent admission finding was recorded as acute urinary retention (63.4%) and there were no life-threatening clinical situations.

The first preferable option in the treatment algorithm of acute urinary retention caused by urethral stones is the placement of a suprapubic cystostomy catheter¹⁶. The treatment procedures to be applied afterward should be evaluated according to the patient's age, clinical findings, stone localization, size, shape, and the anatomical state of the urethra¹⁷. Removal of the stone from the external mouth of the urethra using physical manipulation with intraurethral 2% lidocaine gel is a treatment method that can be performed under local anesthesia with 10 mm small stones located in the anterior urethra. In a study by El-Sherif and El-Hafi, 18 patients with urethral stone less than 10 mm, without urethral stricture and history of previous urethral surgery were examined. In this study, the success

rate of intraurethral 2% lidocaine gel application was reported as 77.8%¹⁹. Another treatment modality that can be applied under local anesthesia is endoscopic removal of urethral stones with forceps or with the aid of a basket. However, using these two methods in the repair of urethral mucosa in patients with large urethral stones without smooth surfaces and in patients with urethral pathology is not recommended because it can cause severe damage⁵. Meatotomy or urethroplasty is the preferred treatment modality for navicular fossa and urethral meatus, especially for stones that reach large sizes or have lumen impaction^{5,13,20}. In the treatment of posterior urethral stones, endoscopic advancement into the bladder and fragmentation by electrohydraulic, ultrasonic, or laser lithotripsy is a reliable and widely used method of treatment by urologists. Using endoscopic methods should be preferred when advancing posterior urethral stones to the bladder. Thus, before the urethral stones are advanced to the bladder, it is possible to treat predisposing factors of stone formation, such as urethral stricture, effectively and correctly. On the other hand, it should be kept in mind that non-observations of these procedures may result in undesirable situations such as false urethral passage. Considering the progress in endourological methods in proportion to the technological developments in the medical world, open surgical procedures should be considered as the last treatment option in the treatment of urethral stones. Kamal et al. in their study planned to make a stone fragmentation advancing into the bladder by means of endoscopic method in the treatment of all posterior urethral stones and reported the success rate of the procedure as 86%. In situ lithotripsy was performed on the remaining urethral calculi which could not be pushed back to the bladder and the success rate was recorded as 80%⁵.

In urology practice, laser is used to treat diseases such as benign prostatic hyperplasia, urethral strictures, urinary tract stone diseases, skin lesions, ureteropelvic union obstructions, and urogenital malignancies. Lasers act with a combination of three mechanisms: photothermal, photomechanical, and photochemical. Holmium: Yttrium-Aluminum-Garnet laser is the most widely used type of laser. It is 2120 nm in wavelength and absorbs rapidly in water²¹. It is indicated as an effective and safe treatment method in the treatment of ureteral and intrarenal stones²². However, there are very few studies related to its use in urethral stones. Maheshwari and Shah in their study of 42 patients with urethral stones reported 100% success with in-situ holmium laser lithotripsy applied to 18 patients when retrograde manipulation could not be applied and reported that they did not suffer intraoperative complications²³. Similarly, Walker and Hamilton presented in their study two pediatric patients with impacted ureter stone and reported that in-situ holmium laser lithotripsy is an effective and reliable method²⁴. In our study, endourological methods were likewise preferred in the treatment of posterior urethral stones and holmium laser lithotripsy was 100% successful.

There is a limited number of publications in the literature about urethral stones and no detailed information about treatment algorithms such as is available about other urinary system stone diseases. According to the data obtained in our study, holmium laser lithotripsy was an effective and reliable method in the treatment of posterior urethral stones with low complication

rates and high stone-free rates.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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